REMARKS

This is in response to the office action dated May 12, 2005. The independent claims have all been amended and several of the dependent claims have been cancelled. Claims 1, 5, 7, 8, 10-13, 15-18, 20, 22 and 23 remain in the application. Claims 2-4, 6, 9, 14, 19, 21 and 24 have been cancelled.

Applicant appreciates the fact that the Examiner has considered all the claims and all the embodiments in the application.

A typical spark plug having a single gap has what is referred to in the application as an optimum gap. This gap provides ignition under the worst conditions, however it is made as large as possible in order that the flame kernel be as large as possible. In contrast, the present application teaches using a plurality of secondary electrodes with gaps ranging between one-third and two-thirds of the optimum gap. The present invention makes use of the ionization current that flows before the flame kernel. A resistor associated with each of the secondary electrodes, causes the voltage at the electrode to significantly drop once the ionization current begins to flow. An example is given in the specification on page 5, specifically as:

> If the high voltage supplied to the spark plug electrode is 10,000 volts and the resistor value was 10,000,000 ohms, prior to ionization the gap resistance might be 1,000,000,000 ohms. At those conditions the current flow would be .00001 amps and the voltage at the downstream end of the resistor would be 9,990 volts. But once the gap ionizes, the resistance of the gap drops significantly. If the gap resistance drops to 100,000 ohms, then the total current increases to almost .001 amps. At that current, the voltage drop across the resistor increases to approximately 9,900 volts so that the downstream end of the resistor is

approximately 100 volts above the electrode on the other side of the gap.

Referring to the embodiment of Figure 1, note each of the gaps are slightly different and each of the gaps are between one-third to two-thirds of the optimum gap. For the embodiment of Figure 1, by way of example, once the ionization current flows from electrode 12 through electrode 13, the voltage drop across the resistor 17 causes the electrode 13 to be close to the potential of the electrode 12, then the high voltage on electrode 11 is substantially across the gap defined between the electrodes 13 and 14. Again once an ionization current flows through a resistor associated with the electrode 14, the voltage drop across the resistor not only prevents a large arc from forming but also causes the high voltage to now appear between the electrodes 14 and 15. Gap-by-gap the ionization current advances towards the main electrode 11, with finally a high current arc occurring between electrodes 11 and 12, since there is no resistor in this path.

Rado (4,004,562) teaches a plurality of gaps and uses resistors associated with each of the electrodes that provide these gaps. However, "the length of each gap may be substantially the same and substantially equal to the length of the gap of a single gap plug operating under the same conditions." (Col. 5, beginning at line 44.) Rado does not make use of the pre-ionization current but apparently relies on the total breakdown at each of the gaps. Rado specifically says that "no current flow (occurs) until the first gap breaks down." (Col. 5, lines 18-19.)

In this connection, applicant submits that the drawings in the patent are not intended to be blueprints, and consequently, it is not acceptable to measure the gaps and conclude that the gaps in Rado are unequal. Rather, the patent specifically states that the "gaps may be substantially the same." Moreover, the gap that appears to be the smallest in Rado and breaks down first (the gap between electrodes 28 and 36) corresponds to the embodiment of Figure 1 of the present application and with the teachings of the present application, that gap is made the largest since it breaks down first.

Codina (6,194,819) has but one gap, and once it arcs there are no additional mechanisms in play. This patent appears to be directed towards preventing pre-ignition through use of a electrode that provides better heat distribution.

Hubbard (6,089,201) has central electrodes and a plurality of retractable secondary electrodes. There are no resistors with these electrodes. In one embodiment, the retractable electrodes are extended and the central electrodes turned off when the engine is started. Once the engine is warmed, the retractable electrodes are retracted. In another embodiment "the two central electrodes 24 and 26 in Figure 7 are shut off electrically, the outer electrodes 28 are charged so that each positive electrode has negatively charged electrodes on both sides of it." (Col. 5, beginning at line 7.) Nothing in this reference suggests the pre-ionization current, nor the gap size discussed above.

Claim 1 has been amended to include a plurality of gaps with the gaps being one-third to two-thirds an optimum gap distance in addition to setting forth the ionization current flow limitation previously contained in claim 3. It is submitted that

this claim with these limitations clearly distinguish from Rado, or Rado combined with the other references.

The independent claim 5 also has been amended to include the limitation of the gap distance being between one-third and two-thirds the optimum gap distance. The claim has also been amended to include the resistors coupled to each of the secondary electrodes.

The independent claim 10 also now includes the limitation of the gaps being one-third to two-thirds an optimum gap distance.

The independent claim 18 (embodiment of Figure 7) now includes a limitation that the third and fourth electrodes define a gap which traverses the first gap, and where the second gap is smaller than the first gap. The arrangement of Figure 7 and the arrangement of Figure 8 (claim 20) are a unique, unobvious combination not shown in any of the references.

The independent claim 22 (Figure 9) is also an arrangement not shown in any of the prior art references. Note that the claim calls for a plurality of secondary electrodes, each of which has a clear path to the first electrode. Resistors, coupled to each of the secondary electrodes, have sufficient resistance such that once pre-ionization current flows in one of the resistors, the other electrodes are not precluded from arcing. This distinguishes this embodiment from particularly Hubbard.

Applicant submits that all the claims are now in condition for allowance, and an early allowance would be appreciated.

If there are any additional charges, please charge Deposit Account No. 02-2666. If a telephone interview would in any way expedite the prosecution of the present application, the Examiner is invited to contact Edwin H. Taylor at (408) 720-8300.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: October 7, 2005

Edwin H. Taylor
Reg. No. 25,129

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025-1026
(408) 720-8300